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Regional Vulnerability Analysis

nordwest2050


# How Vulnerable is the Region in Times of Climate Change?

**The vulnerability of a region to climate change depends on two different factors: First, how severe the possible effects of projected climate changes will be, and second, how well developed the capacity of a society is to adapt to the impacts of climate change.**

Both factors have been investigated in the context of the vulnerability analysis for various sectors and fields of activity in the Metropolitan Region Bremen-Oldenburg, North-West Germany. The results show which sectors are endangered, and where more or less adaptation is required. Thus, the vulnerability analysis provides a basis for the development of a regional climate adaptation strategy.

The available knowledge regarding the impact patterns of climate change on today's situation of regionally important sectors and fields of activity have been compiled in the vulnerability analysis. In addition to the scientific analyses, knowledge from regional climate impact research projects and surveys of companies and decision-makers from the region have been used. The results provide an overview of the expected regional impacts of climate change on the natural landscape and on the socio-economic situation, and show the requirement for adaptation over the medium term (to 2050), as well as a long-term perspective (beyond 2050, and until 2100). They will also provide indications of possible conflicts between particular sectors, which result from the requirements for adaptation. The results provide a central starting point for the continued work in nordwest2050 towards a roadmap of change for the region.



## What does vulnerability mean?

According to the international climate research, vulnerability describes how and to what extent a system is likely to be affected by the impact of climate change, and/or will not be capable of coping with it. The concept of vulnerability analysis is composed of the following factors (see figure):

- **Climate change** includes the changes in climatic parameters described in the nordwest2050 climate scenarios (cf. Short & Sharp no. 1)
- **Exposure** describes the climatic changes impacting a certain sector, industry or field of activity
- **Sensitivity** describes the current sensitivity of a sector, industry or field of activity with regard to current climate conditions
- **Potential impacts** are derived from the combination of exposure and sensitivity, without taking into account any additional adaptation measures taken as a reaction to climate change
- **Adaptive capacity** takes into account not only the natural capacity to adapt, but also knowledge regarding adaptation strategies and measures, the technological, institutional or organizational capabilities of the sector, industry or field of activity to plan, prepare, support and implement appropriate measures for adaptation, and the willingness to adapt
- **The vulnerability** of a sector, industry or field of activity is the result of the combination of the above factors.

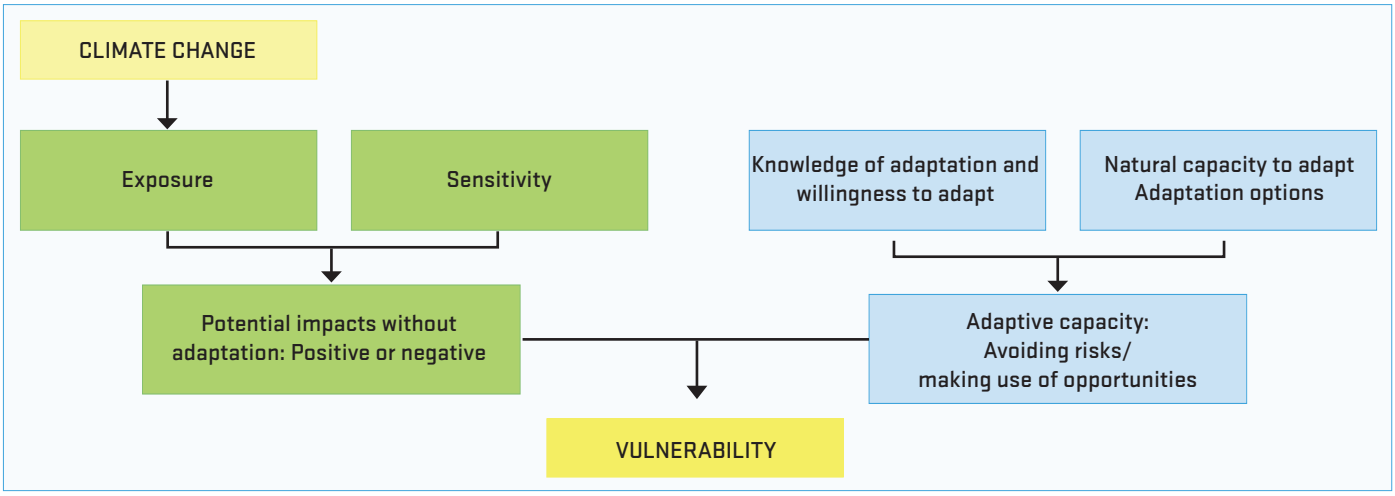


Fig.: Concept of the regional vulnerability analysis for climate change (changed as per EEA 2008).



**Table:** Results of the vulnerability analysis for selected sectors
low medium high vulnerability

| Sector | Impact paths of climate change (examples) | Potential impacts | Adaptive capacity | Vulnerability |
|---|---|---|---|---|
| Coastal protection | The level of safety of coastal protection elements and potential damage of inland areas in case of a moderate rise in water levels: A moderate rise in storm surge water levels would lead to a slightly increased impact and probability of failure of coastal protection structures. The adaptation of these structures, which has already begun (general plan for coastal protection with climate change upgrade and construction reserve) can maintain current safety standards over the short and medium term. | low | high | |
| Tourism sector | The increase in thermal comfort could cause an enhancement of the attractiveness of the coastal region as tourist destinations. Weather-dependent outdoor activities would be more strongly affected by climate change then would indoor activities or urban tourism. The tourist infrastructure could be greatly affected by the increased number of heavy rain and storm days, as well as by the danger of storm surges. | low<br>medium | medium<br>high | |
| Human health | A warmer climate would favour the broader dissemination of mosquitoes, ticks, fleas and bugs, and would thus increase the risk of the spread of infectious diseases, such as borreliosis. In addition, the pollen season would be extended, and would thus extend the period of allergy complaint for people with asthma or hay fever. | low<br>medium | medium<br>high | |
| Human health | Especially for old people, heat waves could lead to health problems and increased death rates. Moreover, extreme events such as storms, floods, or storm surges could cause danger to human health. | medium<br>high | high | |
| Construction engineering | Strong rain, hail, storm surges and storms could lead to direct damage to buildings. In addition, indirect damage could be possible as a result of fluctuations of the groundwater table, and increased impacts from moisture (e.g. cracks in buildings due to ground subsidence, rot). Damage due to frost would decrease. | low<br>medium | medium | |
| Water management and flood protection | Water management on the geest: Dry summers could lead to increased need for irrigation in agriculture and a drop in the groundwater table. That would reduce the amount of groundwater available for the water supply. | low<br>medium | medium<br>high | |
| | Water management in the marsh: The rise of tide water levels and the shift of the brackish water zone would increase the amount of water that needs to be pumped for land drainage. That would reduce the possibility for drawing water from the lower Weser, due to increased salt content, which would in turn cause increased introduction of salt into the waters of the marshlands and into the groundwater in the coastal areas. | low<br>high | medium<br>high | |




**Table:** Results of the vulnerability analysis for selected sectors
■ low ■ medium ■ high vulnerability

| Sector | | | | |
|---|---|---|---|---|
| Water management and flood protection | Water protection, and securing water resources: Rising water temperatures could lead to a deterioration of the quality of water bodies and groundwater, and to restriction of usable water, such as the cooling water used in power plants. | medium | medium high | |
| | Inland flood protection and urban water management: An increase in winter precipitation and heavy rain events could lead to higher impact upon flood protection facilities and the more frequent overload of sewage and drainage systems. | medium high | medium high | |
| Spatial planning | Climate change related demands for action will emerge in the task areas "protection of urban areas in case of extreme weather events", "precaution for biodiversity and nature conservation", "water management and protection of water resources" and "provision for space and risk prevention for inland flooding and coastal protection measures". | medium | medium | |
| Soil protection | The seasonal shift of precipitation could lead to water shortages and restrictions of nutrient availability in summer as well as to super-saturation with water and waterlogging, and increased danger of nitrate eluviation in winter. Increased soil moisture in winter could increase the danger of soil compression. Other effects could include increased water and wind erosion. Effects on the humus content and the soil functions are possible. | medium | medium | |
| Civil and disaster protection | A climate change related increase in intensity of extreme events would increase the personal and financial demands upon protection services for the public and the critical infrastructures. In addition, there could be an increased demand upon the public health system. | medium | medium | |
| Biodiversity and nature conservation | Climate change could lead to a territorial shift of species, the immigration of alien species, and hence a change in habitat communities. This could also affect protected habitats and biodiversity, so that protective goals would have to be re-examined. Climate change will have the effect of an additional stress factor on ecosystems and could thus accelerate changes. | medium high | medium | |
| Coastal protection | The safety level of coastal protection elements and potential inland damage due to greatly accelerated rises in water levels: A major accelerated rise of storm surge water levels would lead to a clearly increased load, and probability of failure of coastal protective structures. In case of failure due to a major expansion and level of flooding, increased inland damage will have to be assumed. Existing coastal protection strategies could reach their limits. | high | low medium | |



## What other aspects will affect the vulnerability of the region?

**The limits of climate scenarios: extreme events and uncertainties**

For society, not only changes of average climatic conditions, but also extreme events, such as heat waves, storms, heavy rain or storm surges are of great importance for the economy and the society, due to their potential for damage. While knowledge of future trends of average climatic conditions is relatively good, in spite of the sometimes considerable ranges, knowledge about the future intensity of extreme weather events is still relatively slight. The nordwest2050 climate scenarios, which are the basis for the vulnerability analyses, only address the extreme events of heat waves and storm surge levels. For this reason, the vulnerability of the region due to the still unknown increase in extreme events could be even greater, especially due to the combination of extremes, such as storm surges and river floods, or storms and heavy rain. Decision-makers thus face the challenge of planning adaptation strategies under conditions of uncertainty, in such a way that they will be able to handle the impacts of the entire range of possible climatic developments.

**Conflicts as a result of climate adaptation**

In the Metropolitan Region Bremen-Oldenburg, adaptation measures will be necessary due to the potential impacts of climate change, both along the coast and in the urban and rural areas. These will involve an additional requirement for space, which may lead to conflicting goals and competition for spatial utilization between the demands of various sectors.
Thus, the required and already initiated adaptation of coastal protection may lead to increased conflicts between such sectors as residential, commercial and industrial spatial development, infrastructural expansion as transport routes or port facilities, conservation of nature, agriculture, and tourism in the coastal and estuary areas. In rural areas, the increased production of energy crops for biomass is in conflict with the goals of environmentally friendly food production and food security. In the cities, there are goal conflicts between the concept of compact – and hence emissions reducing – urban development concepts, on the one hand, and the provision of sufficient open spaces to reduce the effect of urban heat islands, on the other.

Adapted utilization concepts and trade-off processes such as Integrated Coastal Zone Management (ICZM) for multifunctional coastal protection zones, sustainable land management and an integrated urban development may be useful in reducing both current conflicts and future risks for a number of sectors (synergies). For an integrated adaptation strategy, it may be possible to make use of such synergies in order to initiate appropriate measures and options. Thus, the challenges of climate change could also become an opportunity for the sustainable development of the region.

**Global impacts of climate change for the region**

The impacts of climate change, which are occurring globally, are also a factor for the vulnerability of the Metropolitan Region Bremen-Oldenburg, since they affect the region via global supply chains. For the regional tourism sector, competition with currently preferred tourist regions in the Mediterranean area is of importance. Since those areas will probably see a great increase in heat load, their touristic attractiveness could drop. As a result the tourist destinations in the coastal areas of the Metropolitan Region Bremen-Oldenburg could benefit.

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## Summary

- Overall, the regional vulnerability analysis has shown that climate change in the Metropolitan Region is likely manageable in the medium term (i.e., through 2050). In most sectors, the vulnerability is low or medium. That depends, on the one hand, on the fact that climate change is relatively moderate for the region, with the exception of the occurrence of extreme events. Thus, the impacts can be assessed as low to medium. On the other hand, regional societal adaptive capacity can be assessed as medium to high.

- For coastal protection however, vulnerability over the long term – i.e., through 2100 – would be high under conditions of a highly accelerated rise in water levels. In that case, the adaptation strategies considered to date could reach their limits. For the nature conservation vulnerability due to limited natural adaptation capacity, a territorial shift of species and changes in habitats which cannot be prevented, and species based protection goals, is medium to high.

- Vulnerability could increase if on the one hand extreme events which cause great damage become more common, and occur simultaneously – which is, however, currently almost difficult to assess – and if on the other hand, conflicts and risks are enhanced due to complex interactions between adaptation requirements in the region.

- The requirement for action to adapt to climate change is different for various sectors, both with regard to the type and scope of measures, and with reference to the time horizon. Therefore it is necessary to see adaptation as a long-term multi-sectoral process which determines priorities. For this purpose, flexible adaptation strategies capable of taking into account future climate change information are useful. Measures which simultaneously help reduce current conflicts and future risks at the same time would also be appropriate.

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